Space Weather Technical Forecast

Issued on Monday, 13 June 2022 at 01:16 Local

This technical forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

Space Weather Forecast Headline: Slight chance of M-flares.

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Solar activity was Low in the last 24 hours, with only a couple of C-class flares from AR3030. The unnumbered region to the east of AR3030 has been incorporated to it, for consistency with our US counterparts. This region, now Fai/Beta-gamma, is by far the largest and the most complex one, though it remains largely inactive despite its size. The other rgions are relatively small and largely inactive. No Earth-directed CMEs have been observed.

Solar Wind / Geomagnetic Activity: The solar wind speed, as observed by DSCOVR at L1 showed a marked rise from background to slightly elevated levels at 12/0800 UTC, rising quickly from 350-400 km/s to around 450 km/s, likely due to the arrival of a coronal hole fast wind. Density fell from above average to below average levels. Total Interplanetary magnetic field strength, Bt, was initially weak but gradually increased to be Moderate at 12-15nT. The north-south component, Bz, varied weakly between +/-7 nT at first, but strengthened after 12/0800 UTC, generally becoming negative, with brief peaks at -11nT and +13nT. The phi angle was positive (away from the Sun). The overall effect of the above solar wind measures on geomagnetic activity was Quiet initially but largely Unsettled during the second half of the period.

Energetic Particles / Solar Radiation: The high energy proton flux (10 MeV) was at Background levels. Electron flux (greater than 2MeV) was also at background levels. Corresponding 24-hour integrated electron fluence has been well below the Active (1e8 integrated pfu) threshold on a largely steady trend, with 1.55e6 integrated pfu observed at 13/0000UTC.

Four-Day Space Weather Forecast Summary

Solar Activity: Solar activity is expected to be mainly Low through this period, with C-class flares likely and a slight chance of M-class flares.

Solar Wind / Geomagnetic Activity: There are no Earth-directed CMEs. Slightly elevated to elevated winds are expected to vary erratically through Day 1 (13th) from weak coronal hole fast wind influences, before declining on Day 2 (14th). They are expected to rise more significantly on Day 3 and 4 (15th and 16th) to elevated levels, under the influence of the fast wind from CH91 and CH90. Geomagnetic activity is expected to be mainly Quiet with isolated Unsettled intervals, but Quiet to Unsettled with a chance of Active intervals on Day 4 (16th).

Energetic Particles / Solar Radiation: High energy proton flux (greater than 10 MeV) is expected to be at background levels during this period. High energy electron flux (greater than 2 MeV) is expected to start at background levels but may increase to moderate levels during the period, due to high speed stream influences. Electron fluence is expected to remain below the Active threshold throughout, possibly with an increasing trend.

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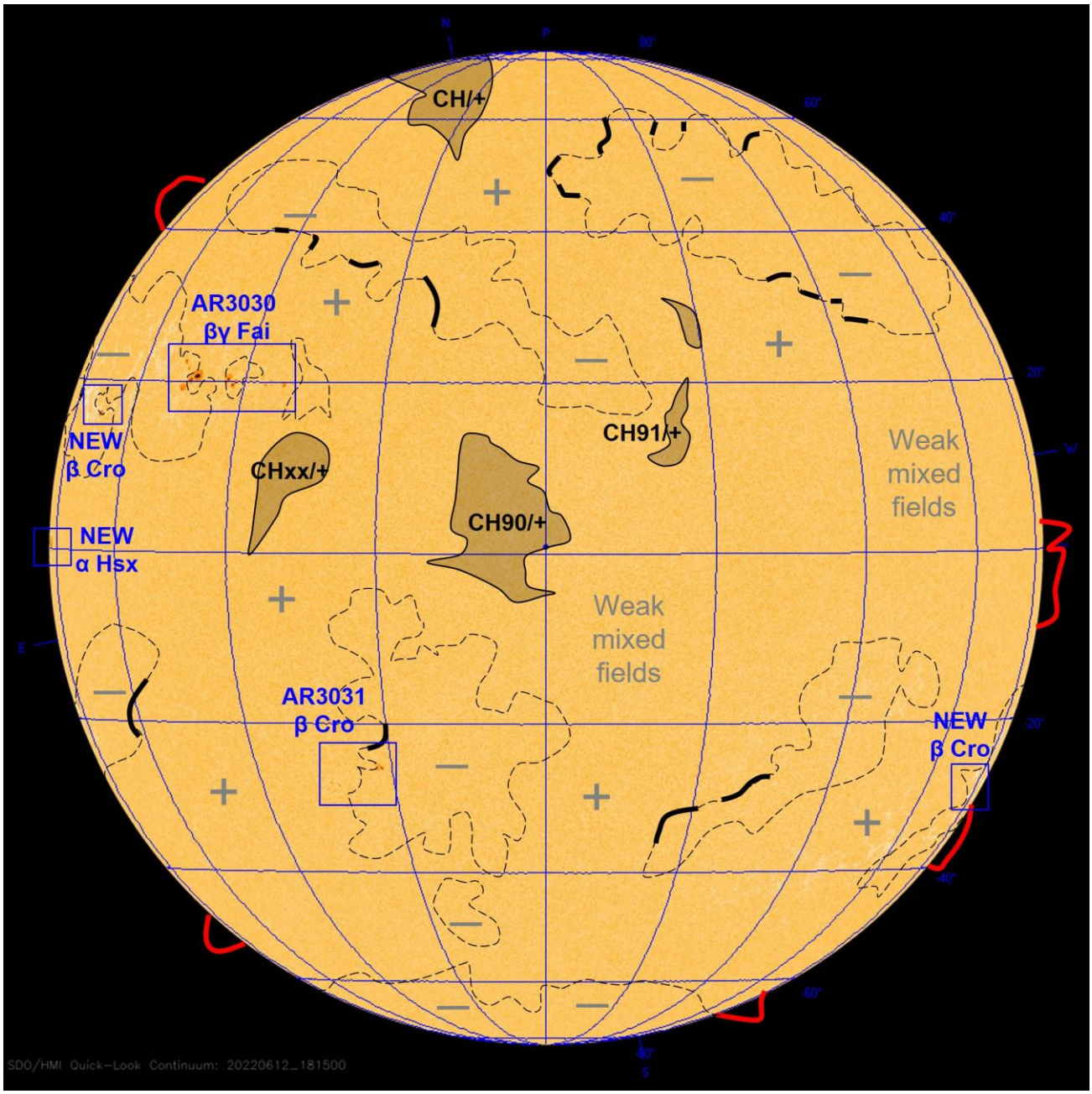
Figure 1. Solar Analysis Valid 12/1800 UTC.



Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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Geomagnetic Storms:

There are no Earth-directed CMEs.

Solar winds are currently slightly elevated under the influence of a weak coronal hole high speed stream. The source of this fast wind is uncertain but may be due to CH89/+. This feature was facing the Earth a few days ago but was small and is no longer visible. There is a coronal hole currently visible on the disc, namely CH91/+, but it is around 18 degrees west and therefore unlikely to affect Earth before a few days. It is however small and likely to enhance solar winds with the same magnitude as CH89. The most significant coronal hole is by far CH90, currently sitting on the central meridian. This is a recurrent feature that generated solar wind speeds of around 500-600 km/s on the last rotation. Similar values are therefore expected this time round, most likely on Day 4 (16th) given the location of CH90 on the visible disc.

Slightly elevated to elevated winds are expected to vary erratically through Day 1 (13th) from weak coronal hole fast wind influences, before declining on Day 2 (14th). They are expected to rise more significantly on Day 3 and 4 (15th and 16th) to elevated levels, under the influence of the fast wind from CH91 and CH90. Geomagnetic activity is expected to be mainly Quiet with isolated Unsettled intervals, but Quiet to Unsettled with a chance of Active intervals on Day 4 (16th).

This is supported by the MOSWOC 27-day solar wind persistence model, and whilst the shape of the coronal holes has changed from the previous rotation, they are still evident on the disc. This is also supported by ongoing slightly elevated to elevated winds observed at STEREO A.

Geo-Magnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	G1 to G2	No	1	1	1	10
Strong	G3	No	1	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

Geomagnetic Activity - Earthbound Coronal Mass Ejections

NIL.

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Radio Blackouts - X-Ray Flares:
There are now five sunspot regions on the visible disc. The unnumbered region to the east of AR3030 has been incorporated to it, for consistency with our US counterparts. This region, now Fai/Beta-gamma, is by far the largest and the most complex one, though it remains largely inactive despite its size. Some of the leading spots have started to vanish but at the same time, two additional spots have appeared on its trailing side, increasing its overall size. Right next to AR3030 is a new region that recently developed, now bipolar with a rudimentary penumbra. AR3031, in the southeast quadrant, is now a mature and largely inactive region that is slowly declining. Another new region has emerged on the eastern limb; it is currently unipolar but more spots may emerge from it in the next few hours. The last region, in the southwestern quadrant, is now close to the limb and should disappear from view very soon. It is however developing, now bipolar with a rudimentary penumbra.

Solar activity was Low in the last 24 hours, with only a couple of C-class flares from AR3030. Judging from the EUVI/AIA 195 imagery, a couple more sunspot regions may appear from the far side over the next few days, increasing slightly the overall probabilities but all things considered, the risk of an M-class flare remains slim. Further C-class flares are expected though.

X Ray Flares	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability			(%)	(%)	(%)	(%)
Active	R1-R2 M Class	No	20	25	30	30
Very Active	R3 to R5 X Class	No	2	2	2	2

Figure 2: SDO hmi-intensitygram and magnetogram of northwest disc, showing AR3030, the largest and most complex region.

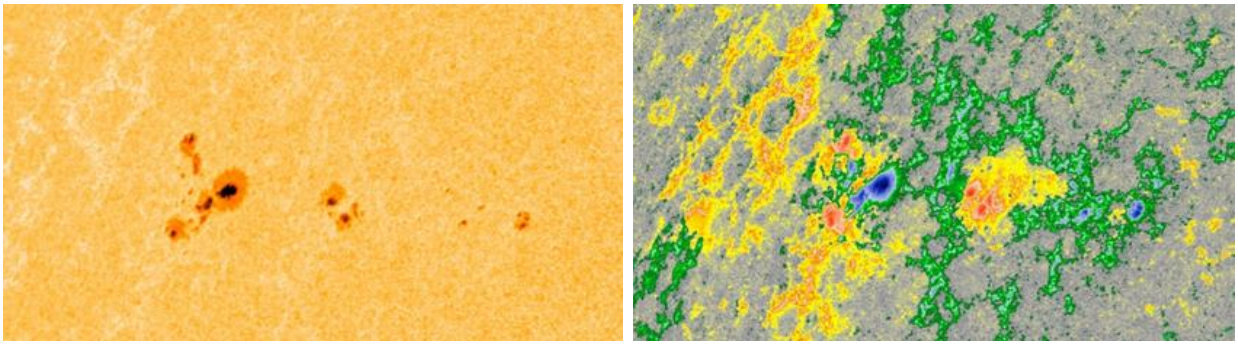

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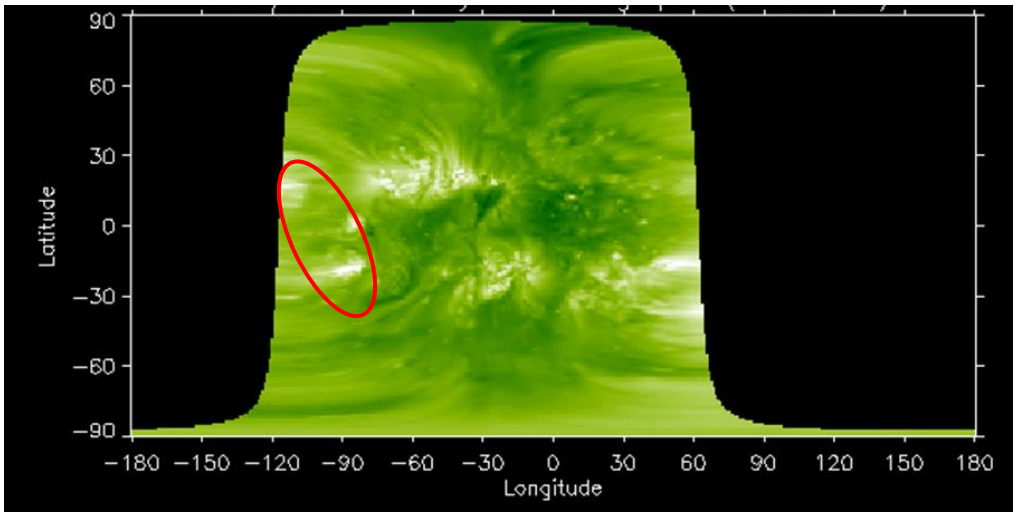
Figure 3: Cylindrical projection of the sun in 195 Angstroms, showing impending bright flux regions over the southeastern and perhaps later northeastern solar horizon, suggesting further emerging sunspot regions in the coming days.



Solar Radiation Storms - (High Energy Protons):

The high energy proton flux (greater than 10 MeV) is at background levels and is currently expected to remain at this level through the period.

Radiation Storms Probability (Exceedance)	Level (cm^{-2} sr^{-1} s^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ S1**	No	1	1	2	2
Very Active	**≥ S3 ***	No	1	1	1	1

* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)

High Energy Electrons Event (≥ 2MeV):

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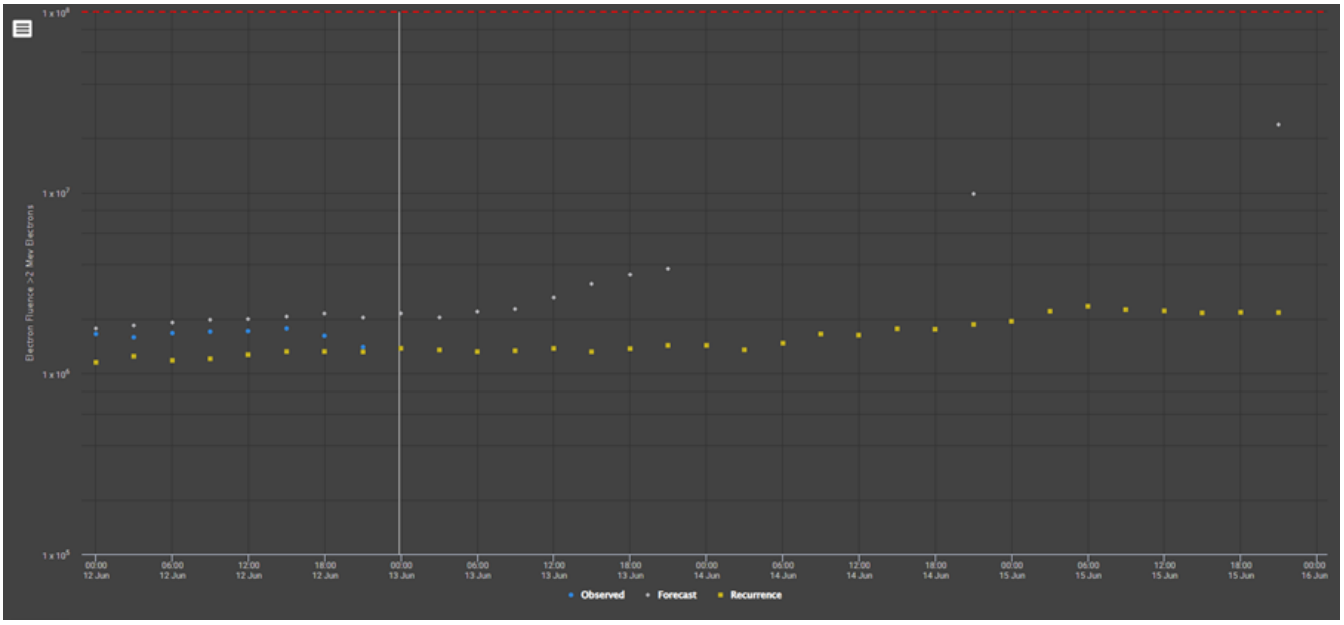
High energy electron flux (greater than 2MeV) as observed by GOES-16 is expected to remain at mainly Background levels through the start of this period. Possible high speed stream influences may give an increase in wind speeds through this period, which could start to cause some minor electron charging. However, geomagnetic response is expected to be limited and as such, charging should remain limited. Therefore a slight increasing trend is possible, perhaps reaching Moderate levels during the period, with a slight chance of reaching a diurnal peak of High.

Electron fluence is currently well below the Active (1e8 integrated pfu) threshold. Whilst a rising trend is possible in response to any flux increase, it is unlikely to reach Active during the period. MOSWOC REFM also indicates a slight rising trend well below Active which is considered good guidance.

GEO Electron Environment Probability (Exceedance)	Level (cm^{-2} sr^{-1} day^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ 2 MeV ≥ $1x10^8$**	No	1	5	5	10
Very Active	**≥ 2 MeV ≥ $1x10^9$**	No	1	1	1	1

Figure 4: Latest MOSWOC REFM forecast (white dots), observed 24-hour fluence values (blue dots) and persistence 24-hour fluence (yellow dots). All are in good agreement, and the slight trend upwards in the 72 hours is accepted.



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